Musto Expl. (PRO/053)

Utah may get only U.S. gallium-germanium mine

Vancourver firm decides "go" at old St. George-area copper-lead-zinc-silver mine

By Gary Dillard
PAY DIRT Staff Reporter

The nation's first primary gallium-germanium mine could be in operation near St. George, Utah by March 1985.

Musto Explorations Ltd. and its subsidiary St. George Mining Company made the production decision November 17th to bring the Apex underground operation on line.

The orebody, which is open at depth, now has proven reserves to turn out a major part of the world's supply of the two metals for about 10 years.

Gallium and germanium are relatively rare materials used in high-technology products. "There's an awful lot of development taking place very rapidly for gallium and germanium," says Lutz Klingman, president of Musto, "so we should see increasing demand."

The average annual production for the first three years should be 10,000 kilograms of contained gallium and 17,900 kilograms of contained germanium. U.S. 1982 consumption of gallium was 9,500 kilograms and of germanium was 42,000 kilograms, according to the U.S. Bureau of Mines.

The mine also will produce 731,000 pounds of copper, 608,000 pounds of zinc and 20,500 ounces of silver a year over the first three years, the company says. Payback on the $12.955 million capital investment should be in three years, Klingmann said.

This will be Musto's and St. George's only active mine. "This will make or break the company," Klingmann said. Musto currently is working on financing for the project, which it hopes will be entirely equity.

Because the company is involved in arranging financing, he could not say how this would be done. Musto is traded on the Vancouver Stock Exchange and is based there.

Musto has been working at the mine since October 7th on renovating past workings and driving a decline to the orebody. The company performed diamond drilling to delineate reserves earlier this year and plans more next year to expand those reserves.

The Apex is an old copper mine, which produced from the 1880s through the turn of the century. The old workings go to the 1,440-foot level.

Recent drilling confirmed recoverable reserves of 184,000 tons grading 0.039 percent gallium, 0.079 percent germanium, 1.91 percent copper, 0.77 percent lead, 1.75 percent zinc and 1.21 ounces per ton silver. Geologic reserves are somewhat larger, but of lower grade for most metals.

The orebody is a "very well-defined vein-

Hazen Research designs and builds one-of-a-kind plant for Apex

By Gary Dillard
PAY DIRT Staff Reporter

When Musto Explorations Ltd. decided to develop its Apex gallium-germanium mine near St. George, Utah, it found that no processing plants existed for recovering those rare metals.

So it went to Hazen Research Inc. of Golden, Colorado to have such a process developed.

Both John Litz, who directed the process development, and Bob Coleman, senior project manager, had dealt with the Apex mine for the past 10 years and were familiar with process needs.

An acid leach process was developed specifically for the Apex mine's ore since there is no other mine like this one in the world, Coleman told PAY DIRT. He explained the operation:

It uses a "very aggressive countercurrent acid leach," he explained. Hazen has worked on the process for two years, with the last year spent on feasibility analysis and process refinements.

The process has to remove not only the gallium and germanium, but copper, zinc and silver as well.

In the process, the ore is crushed and ground and fed into the leach circuit. The tails are washed in a countercurrent decantation circuit.

The tails are slurried in water and then run counter to a sulphuric acid solution in a three-stage circuit. The pH of the acid is 0.5 in the last circuit and 1.5 in the first.

The pregnant liquor is treated for removal of copper via cementation, a very old method.

The solution then is treated by solvent extraction to separate iron, gallium and zinc into strip liquors. The germanium stays with the raffinates.

The iron, gallium and zinc are loaded onto the solvent and then stripped by water.

The gallium is stripped first, then the iron and finally the zinc. Each is then filtered off.

The iron, as an iron hydroxide, is returned to the circuit should it contain any residual gallium. The gallium and zinc are separated as products — gallium hydroxide and zinc carbonate. The liquors are recycled to the solution.

From the raffinate, germanium is precipitated as germanium sulphide. It is further treated by distillation of germanium tetrachloride and precipitated as germanium hydroxide.

When there is silver in the ore, Coleman said, it would be removed along with the cement copper.

The plant is being both designed and built by Hazen. Engineering at the site began the first of October and the plant should be operational within 18 months.

The 100tpd unit is being built in a modular form. "Once you get past the leaching, the equipment gets small," Coleman said.

It will be built on modular skids, pre-piped and pre-wired. The modules will be put together at the site.

The processing plant is "a combination of fairly conventional technology adapted to this particular ore," Coleman said. "The reliability factor is fairly good."

RECOVERY RATES HIGH

Design recovery levels are 80 percent for gallium, 85 percent for germanium, 95 percent for copper and silver and 94 percent for zinc. These are "economically acceptable," Coleman said.

He added that the recoveries could be higher because the mine has a "wide, wide positive flexibility."

There are basically three types of ore, he said, ranging from one that is high in iron and low in carbon dioxide, which is in the form of dolomite, to one that is low in iron and high in dolomite.

The higher the iron and the lower the dolomite, the better the grade of gallium and germanium and the better the recovery of those metals.

As the mine gets deeper, he said, the amount of iron increases.

Hazen now is working on a process that will simply float the dolomite from the ore, Coleman said, leaving tails with a higher iron content.

The plant will operate in early years on higher-grade ore available at the mine, but within two years could be using the flotation system for upgrading the ore before processing, he added.

Hazen won't be able to mass-market its plant, since there are no other known gallium-germanium mines. Coleman said he knows of "none other in the world under development." The metals are produced mainly as byproducts of aluminum and zinc refining.

The Apex mine has been known for years, but it is more attractive now because of the market aspects.

Germanium, for example, is used in fiber optics, which is "becoming such a major market it's dangerous to depend on byproducts," Coleman said.

type in a totally oxidized iron [illegible]ne," Klingmann said. Musto was able to define the reserves in a drilling program that ran from January through August, but it was unable to check reserves below the 625-foot level.

GREATER ORE RESERVES

What was delineated is "only a portion of the total ore reserves," Klingmann said. "We expect reserves to double and perhaps to triple," he said, adding that "that's only speculation."

Musto defined only enough reserves to make a production decision. Once production is under way, the company will have cash flow for further drilling. Klingmann said the vein has a small surface exposure but rapidly widens along strike and in thickness.

Musto has rehabilitated two adits that access the mine at the 250 and 500 levels. They enter the mine from the side of a hill. Work now is under way in driving a decline from the 500 level to the 625 level. That decline, [illegible] 15 percent grade, will be about 830 feet long.

Klingmann said he hopes the decline will reach the orebody next March. The company wants to confirm tonnage and grade reported from drilling, but more important, wants to test its planned mining methods.

Mining at the Apex will be "difficult and expensive," he said. Musto plans to use cut-and-pneumatic-fill mining. There may be a problem with weak roofs, he said, which would require extensive support.

Underground development is being done through a contractor.

Musto may start mining ore to test mining methods and stockpile the ore on the surface.

The most innovative part of the operation will be the mill, a 100tpd acid leach process that was developed specifically for the Apex mine by Hazen Research Inc. of Golden, Colorado. (See separate story on the mill circuit.)

Hazen also is building the plant in modules, which will be shipped to the mine site for simple construction.

The ore will be crushed and ground to a -35 mesh for feed into the acid leach. The leaching will remove the various metals. Musto has set "quite a low target" for ore production — only about 24,000tpd, or 100tpd for 240 days a year.

"This project would not be a project where we would ever push tonnage," Klingmann said. Rather, upgrading would be in the form of producing a higher-quality product, which would have more value added, he said.

Musto will be earning (net to the company) about $515 per kilogram for the germanium and $210 per kilogram for the gallium. Those are the figures the company used in its feasibility study. The difference between those figures and the market price would be the refining charge, Klingmann said.

Germanium metal sold for $1,060 per kilogram in 1982, the same as in 1981, but up from $348 in 1978, according to the Bureau of Mines. Gallium went for $630 per kilogram last year, the same as in 1981 and up from $550 in 1978, the bureau said.

What are uses for two rare metals?

By Gary Dillard
PAY DIRT Staff Reporter

Just what are gallium and germanium, the two main metals to be produced at Musto Explorations Ltd.'s Apex mine near St. George, Utah?

Who uses how much of them for what? Answers to the questions come from the U.S. Bureau of Mines' "Mineral Commodity Summaries 1983."

GALLIUM

Two companies, one with a plant in Bauxite, Arkansas and the other with a plant in Quapaw, Oklahoma, accounted for the domestic production of gallium last year.

It was recovered from zinc processing wastes and recycled bauxite process fluids.

More than 90 percent of it was consumed in electronic applications. About 30 firms use gallium intermetallic compounds to produce light-emitting diodes for visual display panels in calculators, radios, bubble memory devices, semiconductor devices and the like.

There are substitutes. Liquid crystals made from organic compounds are used in some display panels. Silicon and germanium are alternate materials in many semiconductor applications.

If current research on the direct conversion of sunlight to electricity using gallium compounds is commercially successful, increased demand for gallium can be expected. Increasing demand for gallium-based military electronic devices also can be anticipated.

Most of the world's gallium requirements were recovered as a byproduct of the extraction of alumina from bauxite. Recovery from zinc smelting was the second major source.

Refinery production in 1982 was not available. Imports were 6,000 kilograms and reported consumption was 9,500 kilograms. Average price last year was $630 per kilogram.

From a 1978 base, demand for gallium is expected to increase at an annual rate of about 6 percent through 1990.

GERMANIUM

The main sources of germanium last year were processed residues from certain domestic zinc ores, industry-generated scrap and imported raw materials.

Major uses for germanium were infrared optics, 43 percent; semiconductors, 18 percent; fiber optic systems, 16 percent; and detectors, 12 percent. Other applications include catalysts, phosphors, metallurgy and chemotherapy.

Substitutions are possible in some uses, but germanium is more reliable in some high-frequency and high-power applications. In infrared guidance systems, substitutes can be made at the expense of performance.

The largest use for germanium continued to be in lenses and windows used in the production of infrared sensing and identification systems. Consumption was believed to have had its largest growth in this use during 1982.

The use of germanium in fiber optic systems also grew during the year but at a slower rate than anticipated.

From a 1978 base, demand for germanium is expected to increase at an annual rate of about 5.8 percent through 1990.

Refinery production was 26,000 kilograms in 1982 and imports totaled 10,000 kilograms. Apparent consumption in the United States was 42,000 kilograms.

Price for refined metal was $1,060 per kilogram in 1982, up from $348 in 1978. For germanium dioxide, the price was $660 per kilogram, up from $195.50 in 1978.

Of Mines And Men

F. Harlan Flint Jr. has been appointed director of government and public affairs for Kennecott at Salt Lake City, a new position that consolidates what has been separate positions.

Flint will succeed O.C. Madsen, Kennecott's director of government affairs, who will be retiring early next year after more than 46 years of service to the company.

Under the new structure, K.C. Hochstetler, who has been director of communications and public affairs, will report to Flint.

Flint joints Kennecott from its parent company, Standard Oil Company (Ohio), in Cleveland, where he was director of policy and planning in the government and public affairs department. He has been with the company since 1970 and has served in a variety of government affairs, administrative and legal capacities with Sohio and BP Alaska.

Flint is a native of Providence, Rhode Island and received his undergraduate and law degrees from the University of New Mexico in Albuquerque. Prior to joining Sohio, he spent a number of years in state government in New Mexico, serving as legal counsel to various agencies and later as assistant attorney general.